Sudbury Neutrino Observatory Background Analyses

A. W. P. Poon, A. Schülke, C. E. Okada, Y. D. Chan, X. Chen, M. Dragowsky, K. T. Lesko, E. B. Norman, and R. G. Stokstad

Our group is heavily involved in understanding the background in the SNO detector. Over the past year, we have been using the Parallel Distributed Systems Facility (PDSF) maintained by the National Energy Research Scientific Computing Center (NERSC) to simulate with high statistics various background signals in the SNO detector. Our activites are summarized in the following.

The most troublesome type of background at SNO is the decay of natural radionuclei contained in the detector materials. The β-γ decays of daughter radionuclei of ^{232}Th and ^{238}U occur at the level of $\sim 10^9$ event/year, and can generate γ rays of enough energy to photodisintegrate deuterons in a similar manner as the neutrinos in neutral current reaction in SNO. Also the lower the level of β-γ's in the detector, the lower an analysis threshold we can set in SNO. A low analysis threshold is important to look for energy spectral distortions that are inherent in the neutrino oscillation mechanism.

One source of external background signals that can mimic solar neutrino signals is the high energy ($E \lesssim 10$ MeV) γ-ray events originating from the surrounding rock of the SNO cavity. Similar to the situation in the β-γ's, simulation of the rock γ-ray is computationally intensive. In addition neutrons originating from the cavity wall can also contribute to the backgrounds in the solar neutrino energy region.

Using the PDSF facility, we generated $\beta - \gamma$ events originating from different detector components, high energy γ-ray, fast and thermal neutron events from the cavity wall at different D_2O and H_2O levels with high statistics. Figure 1 shows the results of one of these simulated cavity-wall γ-ray simulations. Efforts are being devoted to reconciling this simulated data to the partial-fill data from the commissioning of the SNO detector.

In the coming year we will continue our effort of accumulating Monte Carlo background events in the filled detector scenario. These events will include $\beta - \gamma$'s from the PMT's, PSUP, outer H_2O shield, acrylic vessel, and D_2O. Also included will be backgrounds originating from the cavity wall.

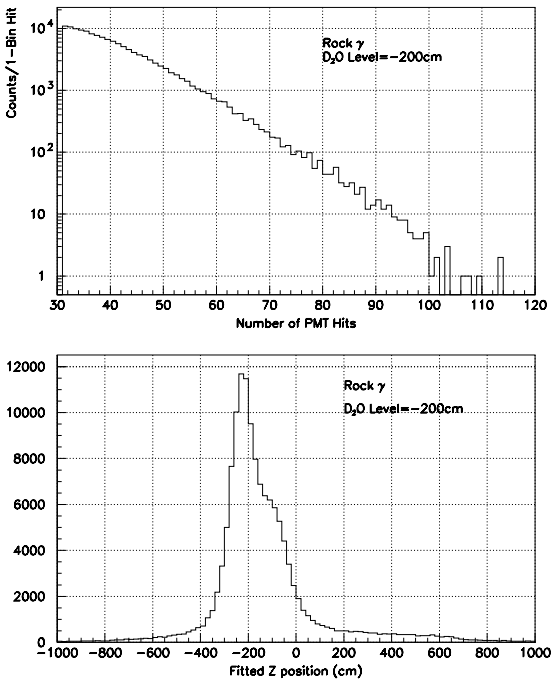

Figure 1: Histograms showing the Monte Carlo simulated Nhits spectrum and the reconstructed z position of simulated rock γ-ray events for a D_2O level of 200 cm below the detector's equator.